

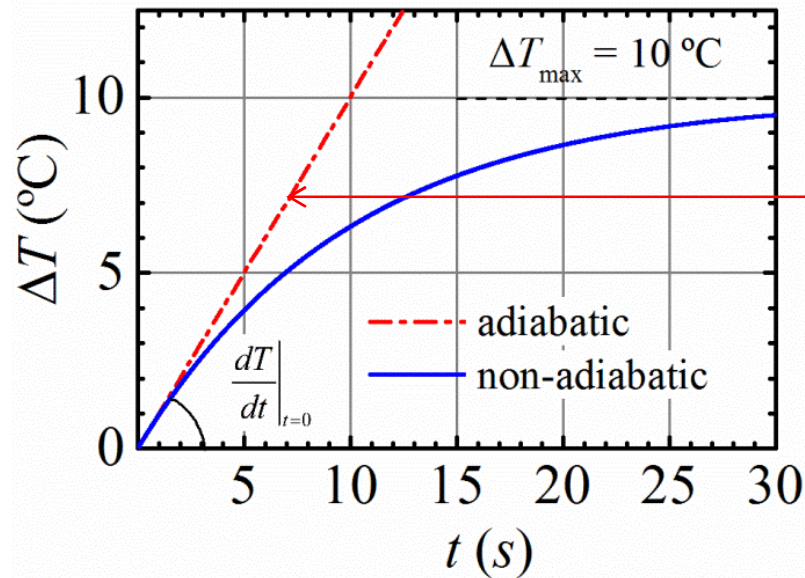
Progress report of WG4
***“Instrumentation: thermometry aspects and
development of hyperthermia set-ups”***

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Carlton Jones (Nanotherics Inc.)



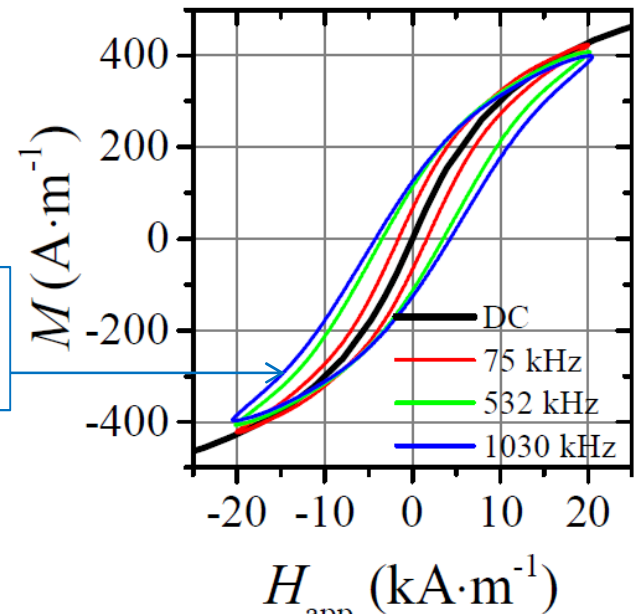
Overview of MFH applicators (presented in Lisbon)

- Lab-made / Commercial setups
- SAR measurements / *In vitro* (cellular) / *In vivo* (pre-clinical) MH setups
 - Mono-frequency / Multi-frequencies setups
 - Open coils / Ferrite circuits with gap
 - Adiabatic / Non-adiabatic setups
- Calorimetric / Magnetometric measurements



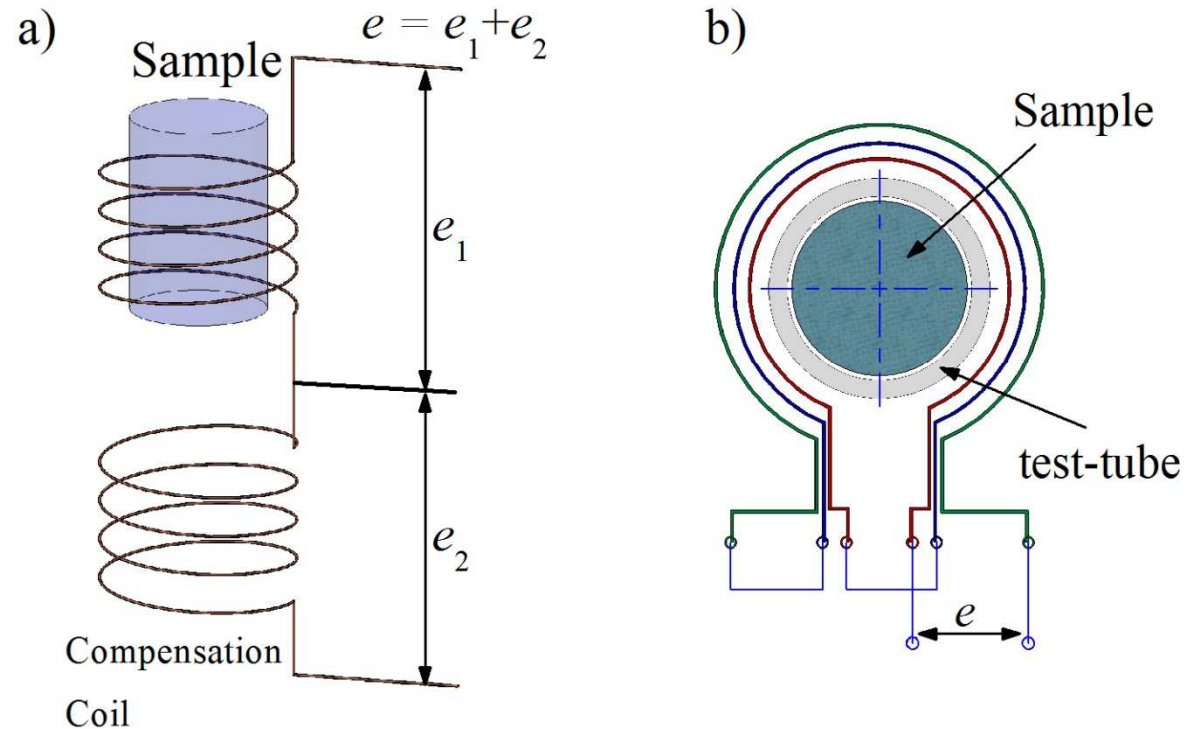
$$SAR = \frac{m_d \cdot C_{p,d}}{m_{NP}} \cdot \left. \frac{dT}{dt} \right|_{t=0}$$

$$SAR = \frac{f}{C} \cdot \oint_T M_t \cdot dH_t$$



From E. Perigo et al, “Fundamentals and advances in magnetic hyperthermia”, accepted in *Appl. Phys. Rev.*, [arXiv 1510.06383](https://arxiv.org/abs/1510.06383)

Pick-up coils to measure dynamic hysteresis



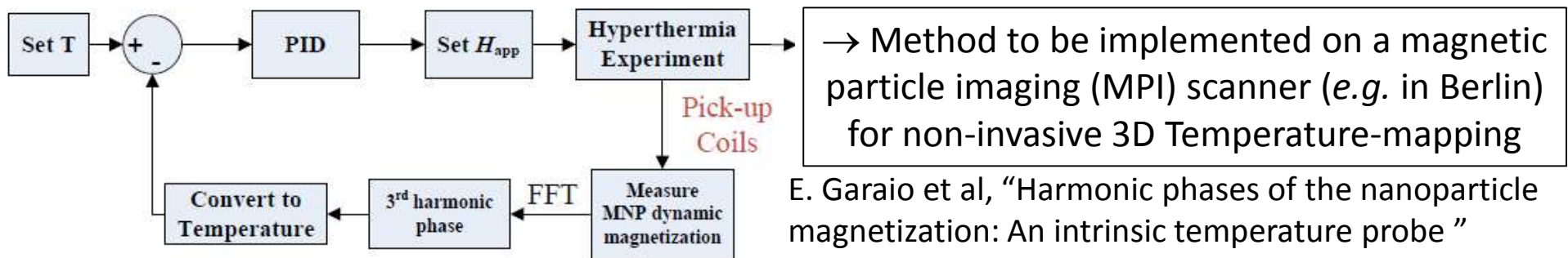
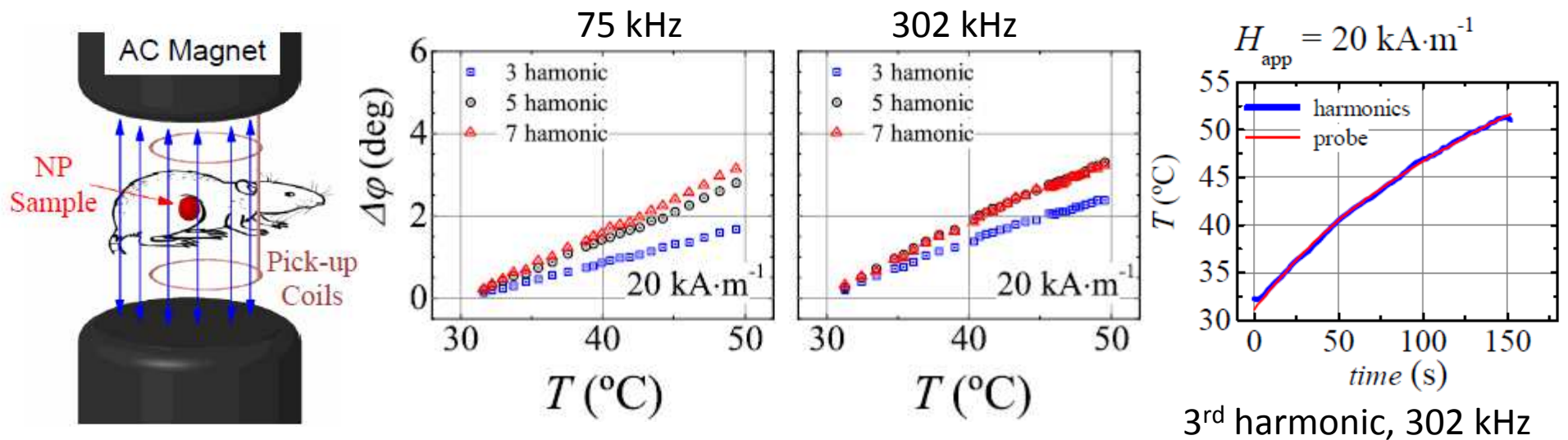
Developed in PhD theses: Eneko Garaio (Plazaola group, Bilbao), Vincent Connord (Carrey group, Toulouse), Clément Guibert (Ménager group, Paris). Also in Slovenia (Mirabor) by Milos Bekovic.

→ Method to be implemented on commercial setups (nanoScale Biomagnetics™, Nanotherics™, ...)

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Two priorities for future short-term scientific missions:

- MH setup standardization: H field frequency/intensity specification (peak-to-peak, MAX and RMS values) and cross-checking of setups using the calibration ferrofluid(s)
- Thermometry: localized (*e.g.* fiber probe) *versus* “contact-less” thermometry methods



→ Method to be implemented on a magnetic particle imaging (MPI) scanner (*e.g.* in Berlin) for non-invasive 3D Temperature-mapping

E. Garaio et al, “Harmonic phases of the nanoparticle magnetization: An intrinsic temperature probe ”

[Appl. Phys. Lett., 107, 123103 \(2015\)](#)